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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>D21H 21/42, B42D 15/00, B41M 3/14</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/44199</b> <b>(43) International Publication Date:</b> 8 October 1998 (08.10.98)
<b>(21) International Application Number:</b> PCT/GB98/00954 <b>(22) International Filing Date:</b> 31 March 1998 (31.03.98)  <b>(30) Priority Data:</b> 9706749.0                      3 April 1997 (03.04.97)                      GB  <b>(71) Applicant (for all designated States except US):</b> DE LA RUE INTERNATIONAL LIMITED [GB/GB]; 6 Agar Street, London WC2N 4DF (GB).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> ISHERWOOD, Roland [GB/GB]; 1 Paul's Heath Cottage, Cole Henley, Whitchurch, Hampshire RG28 7QJ (GB). HASLOP, John, Martin [GB/GB]; 22 Radcot Close, Woodley, Reading, Berkshire RG5 3BG (GB).  <b>(74) Agent:</b> BOULT WADE TENNANT; 27 Fumival Street, London EC4A 1PQ (GB).		<b>(81) Designated States:</b> AU, BR, CA, CH, CN, DE, DK, ES, FI, GB, ID, JP, KR, PL, RU, SE, SI, UA, US, UZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> SECURITY ELEMENT FOR SECURITY PAPER    <b>(57) Abstract</b>  The invention relates to a security element for security paper for banknotes and the like having both aesthetic and anti-counterfeitable qualities. The invention comprises a security element for wholly or partially embedding in security paper comprising an elongate strip of a light transmitting polymeric substrate. The substrate bears a reflective metallic layer on at least one surface thereof in the form of a design. The design comprises at least one repeating geometric pattern of which one or more of the frequency, instantaneous amplitude and/or maximum amplitude of the pattern varies along the length of the element, said design having at least one non-linear boundary.		

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- 1 -

SECURITY ELEMENT FOR SECURITY PAPER

5       The invention relates to a security element for security paper for banknotes and the like having both aesthetic and anti-counterfeitable qualities.

      It is widely known to use in banknotes and other security documents security elements, such as security threads or strips, which are made from a transparent film provided with a continuous reflective metal layer, such as aluminium, which is vacuum deposited on, for example, polyester film. Banknotes made from such paper have been in general circulation in many countries for many years. When the security threads are embedded in the security paper and the paper is subsequently printed to provide the security documents, the threads cannot be readily discerned in reflective light but is immediately transparent as a dark image when the document is viewed in transmitted light.

20       In recent times, in order to enhance the security of security documents, especially banknotes, against modern counterfeiting techniques making use of the sophisticated colour separation, printing and colour photocopier technology, it has become common to use a security thread comprising a thin layer of aluminium on a plastic support which is exposed on one side of the sheet at intervals along the length of the element, the region of exposure being referred to as a window. GB-A-1,552,853 and GB-A-1,604,463 disclose banknotes containing such windows. Paper for use in producing such banknotes can be made using the method disclosed in our European Patent Specification EP-A-0,059,056. The widespread use of banknotes having security threads exposed in windows along the length of the element has resulted in enhanced security. A

- 2 -

banknote of this type provides added security against counterfeiters as, when viewed in transmitted light, the strip is seen as a dark line, and, when viewed in reflected light on the appropriate side, the bright shiny aluminium portions which are exposed at the windows are readily visible. However, there is a need for even greater security by the use of more sophisticated devices in order to render the task of a would be counterfeiter more difficult as the reflected light appearance of the exposed aluminium portions of a security device can be simulated by modern materials and techniques, for example by the use of hot foil stamping.

More recent developments in this field include security paper with a security element as described in US-A-4,652,015 in which a resist and etch technique is used to selectively demetalise regions of a vacuum deposited aluminium layer on a polyester film thereby leaving security indicia comprising metal characters on the plastic strip. The strip is wholly embedded in the paper and the metal characters are undetectable to the unaided eye and in reflective illumination whilst only becoming legible in transmitted light. However, this type of thread is unsuitable for windowed applications. Because the characters are discrete and separated, the resulting look in windows is confusing and uneven.

A further improvement described in our patent specification EP-A-0,319,157 which describes the use of a partially metallised film having metal-free portions of between 10% and 50% of the area of the device, the metal-free portions along the length of the device providing a repeating pattern, design or indicia. The metal layer, however, retains a continuous metal path along its length. Banknotes

- 3 -

formed from security threads as described therein provide excellent security and a public security feature in which the threads are eminently "readable" by the public when viewing the threads in transmitted light without the aid of a lens or other viewing accessory. In transmitted light the threads appear as black strips which very clearly stand out against their surroundings. In the embedded version, the threads are almost invisible when viewed with reflected light, although obviously the threads can be used in windowed paper also. In the windowed version, the thread is seen in reflected light as silver blocks in the windows surrounding the metal free areas.

Whilst this type of thread produces an easily recognisable effect suitable for windows or embedding, the straight edges of the negative block can be mimicked by blocking techniques.

In EP-A-0659936 a security thread is described which consists of a light transmitting plastic film with a coating which is at least partly opaque and in which the thread comprises information in the form of visually and/or machine readable characters or pattern which extend from the opaque region into an adjacent light transmitting region. This has the advantage that the visual impression can only be imitated by means of very complex techniques.

EP-A-0659587 describes a security thread which again consists of a light transmitting plastic film with a coating which is at least partly opaque. The coating has light transmitting regions in the form of visually and/or machine readable characters or patterns, which form a first type of information. A second type of information in the form of visually and/or machine readable characters or patterns is additionally disposed on the plastic film and differs

- 4 -

from the first type of information in terms of size and/or visual impression. In the examples described in the specification there is a combination of a negative inscription, which cannot be copied because  
5 of the reflective light/transmitted light effect, with a further type of information which is particularly easy to distinguish by reflective light. Alternatively the protective effect utilises the comparison between large easily legible negative  
10 inscription and a small negative inscription which is visually difficult to resolve on a transparent plastic thread.

It is an object of the present invention to further enhance the security of security elements such  
15 as threads.

According to the invention there is therefore provided a security element for wholly or partially embedding in security paper comprising an elongate strip of a light transmitting polymeric substrate,  
20 such substrate bearing a reflective metallic layer on at least one surface thereof in the form of a design, said design comprising at least one repeating geometric pattern of which one or more of the frequency, the instantaneous amplitude and/or the  
25 maximum amplitude of the pattern varies along the length of the element, said design having at least one non-linear boundary.

The use of a repeating geometric pattern, as opposed to printed messages, has the advantage that it  
30 is more likely to be recognised on a narrow thread than alpha-numeric characters which become less legible as they get smaller. A repeating geometric pattern is aesthetically more attractive than the designs delineated by straight edges which are most  
35 commonly used currently and are described in

- 5 -

EP-A-0319157.

Preferably at least one of the repeating patterns has a maximum width of the reflective metal layer in the transverse direction of 0.8mm and more preferably  
5 of 0.5mm.

In a preferred embodiment of the invention, the width of the security element is greater than or equal to 2mm thus allowing integration of complex surface patterns into the paper substrate.

10 Preferably the design has at least one continuous metal path. This continuous metal path advantageously provides an electrically conductive path extending along the length of the element so that the element may be detected using conventional metal thread  
15 detection equipment on, for example, a used note sorting machine. The property of such threads being detectable with conventional metal thread detection equipment is a valuable property in helping to eliminate counterfeiting. Furthermore, by provision  
20 of a suitable detector, the distribution of metal within the security element may be determined by electrical or other means and compared to a reference pattern to provide a further technique for the authentication of a genuine document containing the  
25 element.

In a preferred embodiment of the invention the design is formed from metallic lines in which the widths of at least some of the lines lie in the range 0.05mm to 0.15mm inclusive. Thus the security element  
30 is designed so that it is exceptionally difficult, if not impossible, for a counterfeiter to mimic the presence of a thread by foil blocking onto paper, one of the traditional methods of counterfeiting threads, without having to resort to reproducing the thread and  
35 embedding it which is not commercially viable for

- 6 -

them. The invention therefore provides enhanced anti-counterfeitability.

The width of at least some of the lines preferably lie in the range of 0.05mm to 0.10mm.

5       The preferred embodiment of the invention of the security element is at least partially embedded in the article. Preferably portions of the security element are exposed at the surface of the article at spaced intervals along the length of the security element at  
10 windows in the article.

Many of the prior art security threads are not suitable for use as windowed threads especially those in which the indicia on the element are discrete and separated. This has a very confusing and uneven  
15 effect in windows and looks very poor. In this embodiment of the invention, on the other hand, the design is such that it has an aesthetic appeal when viewed in the windows and as it is easily recognisable in transmitted and reflected light can be seen and  
20 distinguished clearly.

In a preferred embodiment of the invention the window length is greater or equal to 5mm.

Preferably the repeating geometric pattern is in register with the windows in the longitudinal  
25 direction of a security element so that an identical portion of the design is seen in each window. This makes it harder for counterfeiters as such registration is very difficult to imitate by foil blocking techniques.

30       The security article is preferably provided with printing on at least one side thereof to identify the article, said printing including a pattern corresponding to at least one of the repeating geometric metallic patterns of the security element.  
35 This feature greatly enhances the aesthetic appeal of



- 7 -

the article as a whole, whilst taking advantage of and enhancing the anti-counterfeiting feature of the security element itself.

5 In the security element of the present invention, a transparent colourless polyester film, which is flexible and water-impermeable, is provided with a layer of metal on at least one side thereof. One suitable method is the vacuum deposition of aluminium or another suitable metal. The metallised film is  
10 partially demetallised by a known technique to provide a design as described in more detail below. However, high reflectivity metallic inks or non-metallic opaque inks may be deposited by a printing technique to provide the design. The film is slit to form  
15 individual security elements, or threads, having a width of at least 0.5mm and preferably at least 2mm. The security element is inserted into the paper, e.g. on a cylinder mould paper machine so that it is either wholly or partially embedded within the paper fibres.  
20 The method by which the security element is embedded can either be by the method described in EP-A-0059056 or EP-A-0229654 or EP-A-0070172 or WO94/20683 or any other suitable method. If the method of EP-A-0070172 is used, it should be noted that the security element  
25 requires permeable and impermeable areas.

Whilst the security element can be used in wholly embedded or windowed form, the latter is preferred as the design is then easily recognisable in both reflected and transmitted light, rather than just  
30 transmitted light as in the wholly embedded form.

The windows in the surface of the paper may thus be substantially the same width as the security element or narrower as required in some of the aforementioned specifications.

35 The repeating geometric pattern(s) may be in

- 8 -

register with the windows in the machine direction, so that an identical portion of the design is seen in each window. This requires a registration mechanism to be fitted to the thread insertion equipment at the point of incorporation of the element into the paper at the wet end of the paper making machine.

The finished security paper is printed on one or both sides to identify the article or document formed from the paper. This printing preferably includes one or more of the repeating patterns of the design on the security element itself or indeed the whole design. The security element may have a tinted coat to match the colour of the paper or the printing itself to enhance the visual effect of the metallic pattern.

Alternatively, the polyester substrate may, instead of being colourless and transparent, be coloured with a dye to match the printing.

Figures 1 to 10 illustrate some examples of designs for use on security elements according to the present invention which provide security enhancing features. The designs are made up of one or more varying geometric patterns, the whole combination of which constitutes the design. Each of the designs has at least one non-linear boundary i.e. one of the extreme edges of the overall design.

In Fig. 1 the design has a single repeating geometric pattern the repeating element of which is shown in Fig. 1a, the pattern being created from a single metallic line providing a continuous metal path. The frequency of this pattern varies along the length of the thread.

In Fig. 2, the design has a single repeating pattern made up from the repeating element shown in Fig. 2a. Each element of the pattern touches the adjacent elements, so providing a continuous metal

- 9 -

path along the length of the design. In this design the maximum amplitude of the pattern varies along the length of the security thread, i.e the maximum transverse width of each element of the pattern varies from element to element.

In the design of Fig. 3, there are two repeating geometric patterns each created from a single fine line having repeating elements corresponding to Fig. 3a, the patterns being offset from each other and each providing a continuous metal path. In this design the maximum amplitude of each pattern varies along the length of the thread.

In Fig. 4 the design has two different repeating geometric patterns of which the periodic curve of Fig. 4b provides a first repeating geometric pattern created from a fine metallic line of which the instantaneous amplitude, i.e. the perpendicular distance of each point on the curve from the central axis, varies along the length of the thread. In this design there is a second repeating geometric pattern, the repeating elements of which is shown in Fig. 4a, each element being discrete. The transverse width of each discrete element is preferably 0.8mm or less, and most preferably 0.5mm. A continuous metal path is provided along the length of the thread by the first pattern.

In Fig. 5 there are four repeating geometric patterns, each providing a continuous fine metal path. Two of the patterns are created from the repeating element of Fig. 5a and two from that of Fig. 5b. The two identical patterns are inverted with respect to each other about a central axis. The instantaneous amplitudes of each pattern vary along the length of the thread.

In Fig. 6 there are six discrete repeating

- 10 -

geometric patterns each providing a continuous metal path. At least four of the patterns are periodic curves of which the instantaneous amplitudes vary along the length of the thread. The central two  
5 patterns may be straight lines, or may also be periodic curves.

In Fig. 7 there are four repeating geometric patterns each of which comprises a periodic curve, the instantaneous amplitudes of which vary along the  
10 length of the thread.

In Fig. 8 there are four repeating patterns, each comprising a periodic curve of which the maximum amplitude of the curves varies along the length of the thread. Each of the patterns is identical but offset  
15 relative to each adjacent pattern along the longitudinal axis.

In Fig. 9 there are four repeating patterns, the maximum amplitude of which is constant, but of which the instantaneous amplitudes of each pattern vary  
20 along the length of the thread.

In Fig. 10 the repeating pattern comprises a sequence of adjacent, but not touching, discrete elements in which each element is incrementally different from the element preceding it and the one  
25 following it. Thus the repeating element of each pattern comprises the whole progression from, in this example, spades to hearts to clubs to diamonds and back to spades.

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- 11 -

CLAIMS:

1. A security element for wholly or partially  
embedding in security paper comprising an elongate  
5 strip of a light transmitting polymeric substrate,  
said substrate bearing a reflective metallic layer on  
at least one surface thereof in the form of a design,  
characterised in that said design comprises at least  
one repeating geometric pattern of which one or more  
10 of the frequency, instantaneous amplitude and/or  
maximum amplitude of the pattern varies along the  
length of the element, said design having at least one  
non-linear boundary
- 15 2. A security element for wholly or partially  
embedding in security paper comprising an elongate  
strip of a light transmitting polymeric substrate,  
said substrate bearing a reflective metallic layer on  
at least one surface thereof in the form of a design,  
20 characterised in that said design comprises at least  
one repeating geometric pattern, the pattern  
comprising a sequence of adjacent discrete elements  
each incrementally different from the preceding and  
following elements.
- 25 3. A security element as claimed in claim 1 or claim  
2 in which the repeating pattern has a maximum width  
in the transverse direction of 0.8mm.
- 30 4. A security element as claimed in claim 3 in which  
the width in the transverse direction of the repeating  
pattern is 0.5mm.
- 35 5. A security element as claimed in any one of the  
preceding claims in which the width of the security

- 12 -

element is greater than or equal to 2.0mm.

5 6. A security element as claimed in any one of claims 1 to 5 in which the design has at least one continuous metal path.

10 7. A security element as claimed in any one of the preceding claims in which the design is formed from metallic lines in which the widths of at least some of the lines lie in the range 0.05mm to 0.15mm inclusive.

15 8. A security element as claimed in claim 7 in which the widths of at least some of the lines lie in the range 0.05mm to 0.10mm.

9. A security element as claimed in any one of the preceding claims in which the substrate is colourless.

20 10. A security element as claimed in any one of claims 1 to 8 in which the substrate is coloured.

25 11. A security element as claimed in any one of the preceding claims in which the element has a translucent coloured coat.

30 12. A security article including security paper comprising at least one elongate security element wholly or partially embedded in security paper, said security element comprising an elongate strip of a light transmitting polymeric substrate, said substrate bearing a reflective metallic layer on at least one surface thereof in the form of a design, characterised in that said design comprises at least one repeating geometric pattern of which one or more  
35 of the frequency, instantaneous amplitude and/or

- 13 -

maximum amplitude of the pattern varies along the length of the element, said design having at least one non-linear boundary.

- 5      13. A security article as claimed in claim 12 in which portions of the security element are exposed at the surface of the article at spaced intervals along the length of the security element at windows in the article.
- 10      14. A security article as claimed in claim 12 or claim 13 wherein the window length is greater or equal to 5.0mm.
- 15      15. A security article as claimed in claim 13 or claim 14 in which the repeating geometric pattern is in register with the windows in the longitudinal direction of the security element so that an identical portion of the design is seen in each window.
- 20      16. A security article as claimed in any one of claims 12 to 14 in which the substrate and or the element is coloured or has a coloured coating which matches the colour of the paper in which it is
- 25      embedded.
- 30      17. A security article, especially a banknote, as claimed in any one of claims 12 to 16, said article being provided with printing on at least one side thereof to identify the article, said printing including a pattern corresponding to at least one of the repeating geometric metallic patterns of the security element.
- 35      18. A security element as claimed in claim 17 in

- 14 -

which the substrate or element is coloured or coated with a coloured coating which matches the colour of the printing.



FIG. 1.

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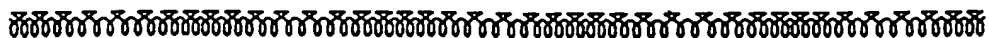


FIG. 2.



FIG. 3.



FIG. 4.



FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.



FIG. 9.



FIG. 10.



FIG. 1a.



FIG. 4a.



FIG. 5a.



FIG. 2a.



FIG. 5b.



FIG. 3a.



FIG. 4b.



# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 98/00954

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 D21H21/42 B42D15/00 B41M3/14

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## B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 400 902 A (PORTALS LTD) 5 December 1990 see abstract see column 3, line 47 - column 7, line 21; figures 5,8 ---	1,2,12, 13,16
A	EP 0 659 936 A (GIESECKE & DEVRIENT GMBH) 28 June 1995 cited in the application see the whole document ---	1,2,12, 13
A	US 4 652 015 A (CRANE TIMOTHY T) 24 March 1987 cited in the application -----	

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/00954

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